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The Discovery and History of Animal and Human Physiology

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Abstract

This study discusses Nucleus, history of the discovery of the cell nucleus Structure and parts of the cell nucleus. All of them is the phisiology of animal and human. The cell nucleus (nucleus) can be defined as an organelle found in eukaryotic cells. Nucleoplasm The nucleoplasm is the liquid that is in the nucleus which is thick and transparent. The cell nucleus has many genes from DNA which are arranged and form structures called chromosomes. The endoplasmic reticulum consists of tubules, vesicles and flattened pockets that occupy the cytoplasmic space. The endoplasmic reticulum is a part of the cell that consists of a membrane system, which has a structure that resembles a multi-layered sac. These sacs are called cisternae.

Introduction

All organisms are composed of cells. Starting from butterfly wings to colorful flower crowns. All composed of cells. Cell is the smallest unit of a life form. For such a small size, cells are classified as extraordinary. The cell is like a factory that is always working so that the life process continues. Cells have parts to support these functions. There are parts of the cell that function to produce energy, some are responsible for cell multiplication, and there are parts that select the traffic of substances into and out of cells. By knowing the components of the cell, we can understand the function of the cell for life.

Nucleus

The cell nucleus (nucleus) can be defined as an organelle found in eukaryotic cells. The cell nucleus contains most of the genetic material such as DNA, chromosomes and various types of proteins (Calogero et al., 1999). In general, cells have only one cell nucleus (nucleus), but several other cells, such as heart muscle cells and liver parenchyma cells, have more than one cell nucleus (nucleus). There are even cells that do not have a cell nucleus (nucleus), such as platelet cells and erythrocyte cells.

The main function of the cell nucleus (nucleus) is to regulate cell activity by managing gene expression and maintaining the integrity of genes. In addition, the cell nucleus also functions as a place to synthesize ribosomes, a place for cell division to occur, a place to produce mRNA for protein coding, a place for transcription and replication of DNA, and a place to regulate the motion of gene expression from starting, executing, and ending.

History of the discovery of the cell nucleus

The cell nucleus or nucleus is the first organelle discovered and researched by experts (McCue et al., 2011). The cell nucleus was first described by Antonie van Leeuwenhoek, who at that time was researching the cell nucleus contained in salmon red blood cells. The depiction of the cell nucleus was also carried out by Franz Bauer in 1802. Then in 1831, the depiction of the cell nucleus was described in more detail by a botanist from Scotland named Robert Brown.

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He examined the cell nucleus in the epidermal cells of orchids. From this research, he could not explain the function of the cell nucleus.

The cell nucleus had a role in the formation of cells, which was later given the name 'cytoblast' which means 'cell builder' (Bechtel, 2006). . He was sure that he had seen new cells forming around the 'cytoblast'. Between 1877 and 1878, Oscar Hertwig investigated a number of studies of sea urchin egg fertilization which showed that the nucleus of a sperm cell enters the egg and then joins the nucleus of the cell. The study is the first time it has been suggested that an individual is formed from a cell nucleus. In addition, Hertwig has also studied other animals such as mollusks and amphibians. In 1884, Eduard Strasburger also obtained similar research results on plants.

Structure and parts of the cell nucleus

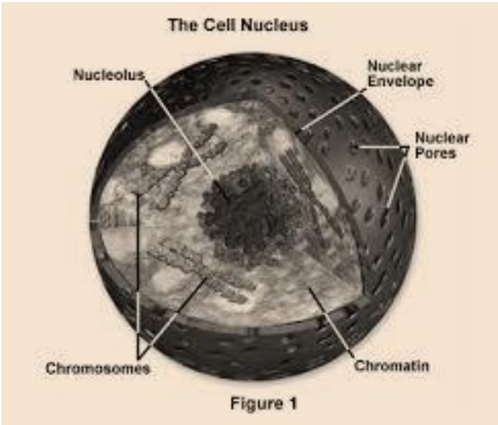

Figure 1. Structure and Parts of Cell Nucleus

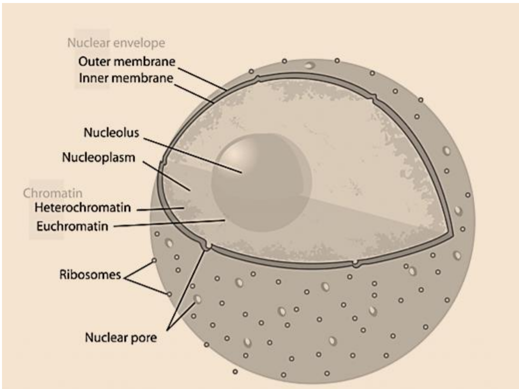

Figure 2. Structure and Parts of Cell Nucleus

The nucleus is the largest organelle in cells, especially in animal cells. In mammals, the diameter of the nucleus is estimated to occupy 10% of the total cell volume and the average diameter of the nucleus is estimated to be about 6 micrometers (Cremer et al., 1993). The nucleus is round or oval in shape and is generally located in the center of the cell. The fluid contained in the nucleus is called the nucleoplasm. The nucleoplasm has a composition similar to the cytosol found outside the nucleus. The structure and parts of the nucleus consist of the nuclear membrane, nucleoplasm, chromosomes and nucleoli (nuclear children).

Core membrane

Pierre et al. (2012) stated The main structural element of the cell nucleus is the nuclear membrane. In eukaryotic cells, the cell nucleus is covered by a nuclear membrane. Broadly

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speaking, the nuclear membrane is divided into three parts, including: (a) Inner membrane (b) Perinuclear space: the space between the inner membrane and the outer membrane. (c) The outer membrane, often directly connected to the rough endoplasmic reticulum (ER), which is studded with ribosomes. (d) In the nuclear membrane there are nuclear pores which are useful for connecting the nucleoplasm to the cytosol and making it easier for the cell nucleus and cytoplasm to exchange molecules. Most of these molecules are mRNA which functions for protein synthesis.

The nucleus pore consists of 4 subunits, including: (a) Ring subunit: serves to form the nuclear surface (adjacent to the nucleoplasm) and cytosolic (adjacent to the cytoplasm) of the nuclear pore complex. (b) Subunit annular: serves to form spoke towards the center of the pore nucleus. (c) Lumenal subunit: contains transmembrane proteins which function to attach the nuclear pore complex to the nuclear membrane. (d) Column subunit: serves to form the pore walls of the nucleus.

Nucleoplasm

The nucleoplasm is the liquid that is in the nucleus which is thick and transparent (Zalensky et al., 1995). The nucleoplasm contains granules, nucleoproteins, chromatin threads, and complex chemical compounds. During the cell division process, the chromatin threads will shorten and thicken and easily absorb dyes and form chromosomes to undergo condensation. The chromatin thread itself consists of DNA and protein. DNA strands function to store life information.

Chromosomes

The cell nucleus has many genes from DNA which are arranged and form structures called chromosomes. Each human cell has a DNA strand 2 meters long. In the cell nucleus also forms a complex DNA protein known as chromatin. There are 2 types of chromatin, namely heterochromatin and euchromatin. Heterochromatin is a more complex form of DNA and contains transcribed DNA. Euchromatin is a simpler form of DNA and contains genes that are ejected by cells.

Nucleolus

The nucleolus is a sub-nucleus that is present in the nucleus and is round in shape (Moga et al., 1989). The nucleolus is composed of enzymes, DNA,phosphoproteins, and orthosfate. The nucleoli are not surrounded by a membrane and are often called sub-organisms. The main function of the nucleolus is to produce ribosomes and synthesize rRNA. The activity of the nucleoli can affect the structure of the nucleoli. The nucleolus is not a fixed organelle. The nucleoli will shrink or disappear if rRNA synthesis stops.

Function of Cell Nucleus (Nucleus)

The main function of the cell nucleus is to duplicate DNA and control gene expression in the cell (Zanta et al., 1999). Another function of the cell nucleus is to transcribe genes that are separated from the transcription site in the cytoplasm. The function of the cell nucleus in animal cells and plant cells is almost the same, because both are eukaryotic cells. The following are some of the functions of the cell nucleus. Pre-mRNA processing the primary transcript undergoes post-transcription modification in the nucleus before getting exported to the cytoplasm. Post-transcription modification involves a variety of biological processes, such as 5 'cap, 3' poly adenylation, and RNA splicing. This process is very necessary before starting translation. In the cell nucleus, pre-mRNA is linked to heterogeneous particles of ribonucleoproteins (various proteins in the complex). Ribosome synthesis and mRNA production occur in the cell nucleus.

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Grouping in the cell the nucleus of the cell is able to control what is in it, and copy it to the cytoplasm as needed. The function of the nuclear envelope is compartmentalization of the cell. This function is used to control the performance of the core membrane. This requires the separation of the contents of the nucleus from the cytoplasm in order to maintain the identity of the nucleus. To regulate the transcribed genes, cells will separate several transcription factors and proteins that are responsible for regulating gene expression from access to DNA to activation. In addition, the nuclear layer also separates the nuclear processes from the cytoplasmic processes and prevents the translation of the unconnected mRNA, which is the result of the mRNA splicing process.

Expression of Nucleus Gene contains a variety of proteins that are useful for regulating the transcription process. One of the important functions of the cell nucleus is gene expression through DNA transcription. This involves the activity of a wide variety of proteins that help in synthesizing growing RNA molecules, reversing of DNA, super coiling DNA and ending in the actual transcription process. Proteins and other factors that help in the transcription process are topoisomerase, helicase, RNA pol, and transcription factors.

Genetic information storage media In the nucleus there is a nuclear membrane that functions to maintain DNA in its face (Zhang et al., 2010). The DNA sequence is a very complex sequence, because it consists of genes that represent each species. Site of DNA replication and transcription DNA replication is carried out in the G1 phase (during the cell cycle) in the nucleus. After DNA replication is carried out, the cell will undergo a process of mitosis. In addition to DNA replication, the nucleus also functions as a place for DNA transcription, which is the place for the translation of the codes contained in the DNA chain into young RNA or primary RNA. The transcription process is a series of genetic expression.

Regulatory cell cycle the cell cycle starts from determining when the cell does not need to divide, when the cell must divide, and when the cell only needs to enlarge. All types of cells generally have this function, except for cancer cells which have been encoded in genes in the cell nucleus. Controlling cellular metabolism the production of protein is carried out through the process of translation and transcription. Each gene produced by means of a DNA template will become a protein. These proteins will then turn into enzymes that have a role in individual (multicellular) metabolism or cellular metabolism.

Kinds of Cell Nucleus

Based on the number of cell nuclei, cells are divided into 2 types, including: (a) Mononucleate cells: cells that have only one cell nucleus. These cells are found in many animal and plant cells. (b) Multinucleate cells: cells that have more than one cell nucleus. These cells are divided into 2 types, namely binucleate cells (double or two cell nuclei) and polynucleic cells (nucleus more than two cells).

Dynamics and Regulation of Nuclear Cells

Integration and Disintegration

The characteristics of the cell division process are the assembly and remodeling of the nucleoli. Basically, the function of cell nucleoli depends on apoptosis or programmed cell death. During the cell cycle, the sheath and nuclear lamina are disintegrating at the. The main function of the cell nucleus is the replication (duplication) of chromosomes to form new genetic material from daughter cells. In the nucleus also DNA replication occurs.

Core Transportation

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The transport of the nucleus is carried out by the pores that are inside the cell nucleus sheath. This structure also controls the entry and exit of the molecule. When RNA is exported to the cytoplasm associated with importins and karyopherins with the help of exportins, the protein load is carried from the cytoplasm to the cell nucleus. Thus, transportation through the nuclear membrane takes place efficiently.

Endoplasmic Reticulum

The reticulum comes from the word reticular which means woven threads or nets. Because of its location centrally on the inside of the cytoplasm (endoplasm) and because its structure is partially woven and for the most part present in the endoplasm. With the discovery of the Endoplasmic Reticulum, a cell can no longer be considered a bag containing enzymes, RNA, DNA, and material solutions that are limited by the outer membrane as in primitive bacteria. Many of the cavities are lined by membranes which are responsible for vital cell functions, including separation and assembling of enzyme systems. And therefore it is called the Endoplasmic Reticulum (abbreviated RE). Endoplasmic Reticulum (ER) is an organelle that can be found in all eukaryotic cells, both animal cells and plant cells.

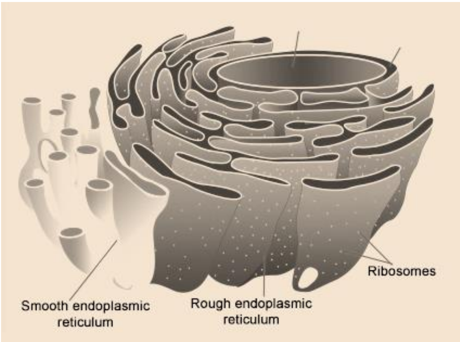

Figure 3. Endoplasmic reticulum

Judging from its shape, there are 3 different forms of the Endoplasmic Reticulum; (a) Lamellar shape (mostly), which consists of the arrangement of a number of flattened membrane sacs. Ribosomes in the ER membrane are lamellar-shaped uneven (asymmetry). The membranes form flattened sacs called cisternae. (b) The shape of the sac (vesicular), mostly there is REH, the space in the endoplasmic reticulum which is shaped like small bubbles. (c) Form tubular (vessels). This shape is mainly owned by REH, in the form of small interconnected pipes. exhibits the dynamic nature of ER and is closely related to membrane movement, separation and fusion in the membrane system (cytocavitary tissue).

Endoplasmic Reticulum in plant cells

In plant cells, the endoplasmic reticulum acts as a channel for the entry of proteins in the membrane. It also plays an important role in lipid biosynthesis and storage. There are a number of soluble membranes, which are linked to enzymes and companion molecules. The general function of the endoplasmic reticulum in plant cells is protein synthesis and maturation. The endoplasmic reticulum in plant cells has several additional functions, which are not found in animal cells. Additional functions involve the cell for cell communication between specialized cells and also serve as a storage area for proteins. The endoplasmic reticulum in plant cells contains enzymes and structural proteins, which are involved in the biogenesis of oil bodies and lipid storage. In plants, the endoplasmic reticulum is connected between cells via plasmodesmata.

Endoplasmic reticulum in animal cells

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In animal cells, the endoplasmic reticulum is a network of sacs, which play an important role in manufacturing, processing and transporting various types of chemical compounds for use inside and outside the cell. It is connected to the double-layered nuclear envelope, which provides a tube between the nucleus and cytoplasm of animal cells. The endoplasmic reticulum in animal cells is a multifunctional organelle, which synthesizes membrane lipids, proteins and also regulates intracellular calcium.

Endoplasmic Reticulum Microscopic Shape

The endoplasmic reticulum has varied functions, this causes morphological variations. There are two types of endoplasmic reticulum as follows:

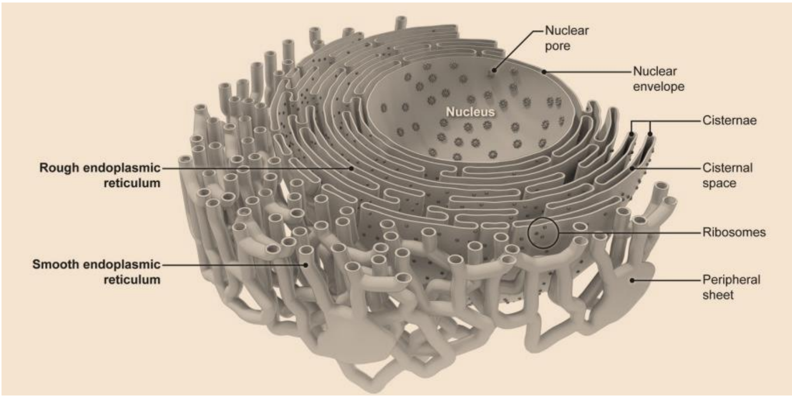

Figure 5. Endoplasmic Reticulum

Rough endoplasmic reticulum (RER)

Rough endoplasmic reticulum, where the membrane facing the cytosol is attached to the ribosome, which functions for protein synthesis, which is then translocated into the endoplasmic reticulum. In the endoplasmic reticulum these proteins will be glycosylated by adding oligosaccharides (containing approximately 14 sugar residues) to the protein. So that glycoproteins are formed, then they will be transported to the Golgi body, lysosomes, and the plasma membrane. The endoplasmic reticulum (ER) has an anabolic and protective role. The role of anabolics is to synthesize cholesterol, steroid hormones and bile acids.

The catabolic role is that it can change or neutralize toxic substances.

The mechanism of action between the Endoplasmic Reticulum (ER) and other organelles such as mitochondria can be interconnected. The crude ER is the incorporation of integral membrane proteins and membrane lipids. The ER has regions that are largely devoid of ribosomes

Smooth endoplasmic reticulum (REH)

The endoplasmic reticulum is smooth, its hyaloplasmic surface does not contain ribosomes. Therefore, it is often called the agranular endoplasmic reticulum. The smooth endoplasmic reticulum is mainly present in cells which plays an important role in lipid metabolism, and has a role in cholesterol synthesis and metabolism of steroid hormones from cholesterol that occurs in adrenal cells, part of the cortex. Smooth endoplasmic reticulum contains enzymes needed for lipoprotein synthesis, for example hepatocyte cells. In addition, it also contains enzymes that play a role in detoxification, for example the enzyme cytochrome p450.

The smooth endoplasmic reticulm functions in a wide variety of metabolic processes, including lipid synthesis, carbohydrate metabolism, and offers water-soluble drugs and toxins. In the smooth endoplasmic reticulum there is also a sarcoplasmic endoplasmic reticulum. Sarcoplasmic ER is a special type of smooth ER. Sarcoplasmic ER is found in smooth and

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striated muscles. What distinguishes sarcoplasmic ER from smooth ER is the protein content. The smooth ER synthesizes molecules, while the sarcoplasmic ER stores and pumps calcium ions. Sarcoplasmic ER plays a role in triggering muscle contraction.

Endoplasmic reticulum function

On the surface of the rough ER, there are spots which are ribosomes. These ribosomes play a role in protein synpses. Thus, the main function of the crude ER is as a site for protein synthesis. Smooth ER Different from rough ER, smooth ER does not have ribosomal spots on its surface. Smooth ER functions in several metabolic processes, namely lipid synthesis, carbohydrate metabolism and calcium concentration, detoxification of drugs, and the attachment of receptors to cell membrane proteins. Sarcoplasmic ER is a special type of smooth ER. Sarcoplasmic ER is found in smooth and striated muscles. What distinguishes sarcoplasmic ER from smooth ER is the protein content. The smooth ER synthesizes molecules, while the sarcoplasmic ER stores and pumps calcium ions. Sarcoplasmic ER plays a role in triggering muscle contraction. RER and smooth ER work together to transport molecules and parts of the cell to one another.

The functions of the endoplasmic reticulum include synthesis of lipids, fats, phospholipids and steroids; regulates carbohydrate metabolism and destroys toxins and drugs in the liver cells; and stores calcium ions which are essential for muscle contraction. In addition, the endoplasmic reticulum also has special functions, including:

Detoxification

In addition to containing enzymes for lipid synthesis, the endoplasmic reticulum also contains detoxifying enzymes for drugs and metabolites that are insoluble in water. The enzyme that plays a role in detoxification is cytochrome P450. The presence of this enzyme makes water-insoluble drugs dissolve in water through a series of chemical processes so that they can be excreted from the body through urine.

Lipid synthesis

In the endoplasmic reticulum membrane produces almost all kinds of lipids needed for the formation of membranes including phospholipids and cholesterol. The resulting phospholipids will be transported by transport vesicles to the cell membrane, the membrane of the Golgi apparatus, and the membrane in the lysosome. Meanwhile, phospholipids for other organelle membranes are carried by proetin transfer phospholipids. (a) Produces ceramide (b) The endoplasmic reticulum membrane produces ceramide which will be carried to the Golgi apparatus as raw material for the synthesis of glyco sphingolipids. (c) Membrane Structure and Composition (d) The structure of the endoplasmic reticulum membrane

In general, the RE membrane is a liquid mosaic model consisting of lipids and proteins. The difference with the plasma membrane in terms of its thickness, the RE membrane is thinner than the plasma membrane. The endoplasmic reticulum itself consists of empty spaces covered with a membrane with a thickness of 4 nm (nanometer, 10-9 meters). This membrane is directly related to the nuclear envelope. The protein to fat ratio is higher and the cholesterol concentration is lower than the plasma membrane. The larger amount of protein causes its structure to be more stable than the plasma membrane, therefore RE has less fluid properties. Endoplasmic reticulum Some eukaryotic cells contain endoplasmic reticulum but we need to know that the number and types vary. for example, the pancreas contains more rough endoplasmic reticulum, whereas in epithelial cells most of the content is smooth endoplasmic reticulum. The total number of different cells in the cells of the pancreas, for example, is very close to the endoplasmic reticulum, whereas in higher plant cells it is only a few. The total

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number and proportion of rough endoplasmic reticulum and smooth endoplasmic reticulum varies depending on the state of cell metabolism. As an organelle that belongs to the membrane system, compared to the cell membrane, the endoplasmic reticulum membrane is relatively thin. This is due to differences in molecular composition. In the membrane of the endoplasmic reticulum, the protein content is higher than the lipid when compared to the cell membrane, thus causing the endoplasmic reticulum membrane to be more stable and thick.

Chemical composition

The endoplasmic reticulum membrane from chemical analysis shows that the endoplasmic reticulum membrane consists of 30% lipids and 70% protein. Lipids are mostly in the form of phosphatidylcholine. Endoplasmic reticulum membrane contains less glycolipids and cholesterol than cell membranes. While the protein on the membrane of the endoplasmic reticulum is generally a glycoprotein with a molecular weight (BM) of about 10,000-20,000 daltons. With freeze-fracture and cytochemical techniques, it can be seen that some of these proteins are enzymes and the electron transfer chain. The enzymes found in the membranes of the endoplasmic reticulum vary widely, including glucose-6-phosphatase or nucleoside phosphatase and cosyltransferase. Glucose-6-phosphatase or nucleoside phosphatase is an enzyme that plays a role in fatty acid metabolism, phospholipid synthesis and steroids. Meanwhile, cosyltransferase is an enzyme that plays a role in the synthesis of glycolipids and glycoproteins

The contents of the endoplasmic reticulum (ER) lumen are fluid containing a number of holoproteins, glycoproteins and lipoproteins. The lumen content of this RE varies greatly with the type of cell and the physical condition of the cell. For example, RE plasmosit (plasma cells) contains immunoglobulins, RE fibroblasts contain protein chains and hydrolase enzymes.

Conclusion

The nucleus is a common organelle in eukaryotic cells. The nucleus is enveloped by 2 concentric membranes that form the nuclear envelop, and the nucleus contains DNA molecules which are polymers encoding the genetic information of organisms. The nucleus was first discovered by Robert Brown in 1931. The cell nucleus (nucleus) consists of 4 constituent components, namely: the nuclear membrane, nucleoli, chromatin and chromosomes as well as nuclear fluid (karyoplasma). Furthermore, the main difference between prokaryotic cells and eukaryotic cells is the location of the DNA, where in prokaryotic cells there is no nuclear membrane so that the cell nucleus is not clear whereas in eukaryotic cells it has a nuclear membrane so that the cell nucleus is clearly visible. The endoplasmic reticulum is a membrane that is folded and is limited by a space called the lumen. Endoplasmic reticulum membrane is composed of lipoproteins. Based on the structure and function, the endoplasmic reticulum can be divided into two, namely the rough endoplasmic reticulum (REK) and the smooth endoplasmic reticulum (REH). The endoplasmic reticulum consists of tubules, vesicles and flattened pockets that occupy the cytoplasmic space. The endoplasmic reticulum is a part of the cell that consists of a membrane system, which has a structure that resembles a multi-layered sac. These sacs are called cisternae. The membrane of the endoplasmic reticulum consists of 30% lipids and 70% protein, while the contents of the endoplasmic reticulum (ER) lumen are fluid containing a number of holoproteins, glycoproteins and lipoproteins. The main function of crude ER is as a site for protein synthesis, while smooth RE functions in several metabolic processes, namely lipid synthesis, carbohydrate metabolism and calcium concentration, detoxification of drugs, and a place for receptors to attach to cell membrane proteins. The RE membrane is able to hydroxylate a substrate giving the cell the ability to perform anabolic and protective functions.

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